

## 1. Child Mouthing of Feces and Fomites and Animal Contact Are Associated with Diarrhea and Impaired Growth Among Young Children in the Democratic Republic of the Congo: A Prospective Cohort Study (REDUCE Program) George, Christine Marie et al.

### Objective

To identify exposure pathways to fecal pathogens that are significant contributors to diarrheal diseases and impaired growth in young children, and to evaluate scalable interventions to reduce fecal contamination from these pathways.

### Study design

Reducing Enteropathy, Undernutrition, and Contamination in the Environment (REDUCE) was a prospective cohort study of 370 children <5 years of age was conducted in Walungu Territory, South Kivu, Democratic Republic of the Congo. Child mouthing behaviors were assessed through caregiver reports and 5-hour structured observations. Caregiver reports of child contact with animals and child diarrhea were also obtained. Anthropometric measurements were collected at baseline and at a 6-month follow-up.

### Results

Children observed putting soil in their mouth during structured observation at baseline had a significantly higher odds of diarrhea at the 6-month follow-up (OR, 1.79; 95% CI, 1.04 to 3.07). **Children observed mouthing feces during structured observation had a significant reduction in height-for-age z-score (HAZ) from baseline to the 6-month follow-up ( $\Delta$ HAZ,  $-0.69$ ; 95% CI,  $-1.34$  to  $-0.04$ ). A significant reduction in HAZ was also observed for children with caregiver reports of touching guinea pigs ( $-0.33$ ; 95% CI,  $-0.58$  to  $-0.08$ ) and rabbits ( $-0.34$ ; 95% CI,  $-0.64$  to  $-0.04$ ) and children with feces in their sleeping space during unannounced spot checks ( $-0.41$ ; 95% CI,  $-0.74$  to  $-0.09$ ).**

### Conclusions

These findings emphasize the urgent need for infant water, sanitation, and hygiene interventions targeting child mouthing behaviors, fecal contamination in child living spaces, and child contact with domestic animals to reduce exposure to fecal pathogens among susceptible populations.

## 2. Diarrheal Disease Awareness Is Associated with Caregiver Handwashing with Soap in the Democratic Republic of the Congo (REDUCE Program)

### Abstract.

Diarrhea is one of the leading causes of childhood illness and a major cause of infant and child mortality globally. In the Reducing Enteropathy, Undernutrition, and Contamination in the Environment (REDUCE) prospective cohort study, we investigated the association between diarrheal disease awareness and handwashing with soap among caregivers of children under 5 years of age. A total of 259 caregivers of children under 5 years of age in Walungu Territory, South Kivu, Democratic Republic of the Congo (DRC), were administered an open-ended questionnaire assessing awareness of diarrheal disease transmission and prevention, and key times to wash hands with soap. An overall diarrhea awareness score was developed based on the responses to these items. Five-hour structured observation of handwashing behaviors was conducted at

the 6-month follow-up. Diarrheal disease awareness among caregivers was low. **Only 32% of caregivers were able to correctly identify a method of diarrhea prevention. The median diarrhea awareness score was 3 out of 10 (SD: 1.7, range: 0–9). During structured observation, 9% of caregivers washed their hands with soap at a food-related event and 9% washed their hands with soap at a stool-related event. Higher diarrheal disease awareness was associated with an increased odds of handwashing with soap at food-related events (odds ratio: 1.40, 95% confidence interval: 1.03, 1.90).**

Our findings emphasize the need for targeted water, sanitation, and hygiene interventions to increase diarrhea awareness and facilitate handwashing with soap among caregivers of children under 5 years in rural DRC.

### **3. Fecal Contamination in Child Play Spaces and on Child Hands Are Associated with Subsequent Adverse Child Developmental Outcomes in Rural Democratic Republic of the Congo: REDUCE Prospective Cohort Study**

Abstract.

The objective of the Reducing Enteropathy, Undernutrition, and Contamination in the Environment (REDUCE) program is to identify exposure pathways to fecal pathogens that are significant contributors to morbidity among young children in the Democratic Republic of the Congo (DRC), and on developing and evaluating scalable interventions to reduce fecal contamination from these pathways. This prospective cohort study of 270 children under 5 years of age was conducted in rural South Kivu, DRC, to investigate the association between *Escherichia coli* in hand rinse, soil, food, object, surface, stored water, and water source samples and child developmental outcomes.

Child developmental outcomes were assessed by communication, fine motor, gross motor, personal social, problem-solving, and combined scores measured by the Extended Ages and Stages Questionnaire (EASQ) at a 6-month follow-up. Children having *E. coli* present in the soil in their play spaces had significantly lower combined EASQ z scores (coefficient: 20.38 (95% CI: 20.73, 20.03)). ***E. coli* on children's hands was associated with lower communication EASQ z scores (20.37 (95% CI: 20.0, 20.01)), and *E. coli* in stored drinking water was associated with lower gross motor EASQ z scores (20.40 (95% CI: 20.68, 20.12)).**

In the REDUCE cohort study, *E. coli* in soil in child play spaces, on children's hands, and in stored drinking water was associated with lower developmental outcome scores (communication, gross motor, fine motor, and problem-solving skills). These results suggest the need for interventions to reduce fecal contamination in the household environment to protect the cognitive development of susceptible pediatric populations in rural DRC.